

Some Mediterranean and Atlantic Sternoptychidæ.¹⁾

Preliminary note

by

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(Plate XVII.)

(From the Danish Oceanographical Expeditions. Leader: Dr. Johs. Schmidt).

The material employed was collected on the cruises of the Danish research steamer „Thor“ in the Atlantic and Mediterranean, supplemented by material procured by the investigation ship „Margrethe“ and various other vessels fishing for the Danish Committee for the Study of the Sea. With regard to the areas investigated and times of investigation etc. reference may be made to the „Report on the Danish Oceanographical Expeditions 1908—10“, Vol. I, Introduction, 1912, and „Meddelelser fra Kommissionen for Havundersøgelser“, Ser. Fiskeri, Bd. V, No. 7, 1919.

In the Mediterranean itself, the following eight species of the family were taken during the expedition: *Gonostoma denudatum*, Raf., *Cyclothone signata*, Garman, *Cyclothone microdon*, Günther (but see below), *Ichthyococcus ovatus* (Cocco), *Vinciguerria attenuata* (Cocco), *Vinciguerria Poweriæ* (Cocco), *Maurolicus Pennanti* (Walb.) and *Argyropelecus hemigymnus*, Cocco.

In the Atlantic there were besides these also taken several species of *Gonostoma* and *Cyclothone*, which will be treated later on, and finally the following:

¹⁾ Of the four genera *Gonostoma*, *Cyclothone*, *Argyropelecus* and *Sternoptyx* the two first will be mentioned in a later work; the two last are dealt with in „Report on the Danish Oceanographical Expeditions 1908—1910“, Vol II, A. 2, 1915, by P. Jespersen, in „*Sternoptychidæ* (*Argyropelecus* and *Sternoptyx*)“. The postlarva of *Argyropelecus hemigymnus* is briefly referred to on p. 153 of the „Report etc.“, Vol. II, A. 7, 1918, by Å. Vedel Tåning, in „*Mediterranean Scopelidæ*“. For the literature, reference must be made to these two works.

Bonapartia pedaliota, Goode and Bean, *Margrethia obtusirostra*, nov. gen. et sp., *Yarella Blackfordi*, Goode and Bean, *Vinciguerria Sanzoi*, nov. sp., *Diplophos tenia*, Günther, *Diplophos minutus*, nov. sp., *Valenciennellus tripunctulatus*, Esmark, and the *Argyropelecus*- and *Sternoptyx*-species dealt with by P. Jespersen. Reference is also made below to two *Sternoptychid*-postlarvæ, the adult stages of which have evidently not been hitherto described. It would seem, then, that there are 13 *Sternoptychid*-species occurring in the investigated area of the North Atlantic, exclusive of all *Gonostoma*- and *Cyclothone*-species and the five *Argyropelecus*- and *Sternoptyx*-species.

The Atlantic distribution of the species further dealt with here has not yet been fully elucidated; we may, however, say that almost all of them belong to the more southerly species, having their main area of distribution south of abt. 40° N. Lat. (which also applies to the majority of *Scopelids*, Vedel Tåning 1918, p. 150); only a single species, viz. *Maurolicus Pennanti*, goes far north.

Before proceeding to a brief mention of the separate species, we may refer to what has previously (Vedel Tåning 1918, p. 17—21) been stated with regard to the metamorphosis stages of *Scopelids*. It should here be added, however, that fishes with similar luminous organs, in respect of ontogenetic migration, from the development of the luminous organs, can apparently be divided into two groups, between which transition forms may possibly be found to occur.

I. Species in which all (or nearly all) luminous organs are developed simultaneously; one can at times, prior to metamorphosis, discern the indications of the organs, but these are then quite unpigmented (see figs. 4—6). As typical forms belonging to this group may be mentioned among the *Sternoptychidæ*: *Vinciguerria attenuata*, *Cyclothone signata* and *microdon*. In species of this group, the vertical ontogenetic migration in individuals in metamorphosis is particularly marked.

II. Species in which the luminous organs are gradually formed (cf. for instance, figs. 8 and 12 with Sanzo's fine work on the *Gonostoma denudatum* in R. Comitato Talassografico Italiano, Memoria IX, 1912). As typical forms belonging to this group may

be mentioned *Gonostoma denudatum*, *Maurolicus Pennanti*, *Bonapartia pedaliota*, *Margrethia obtusirostra*. In species of this group, there is no sharply defined metamorphosis stage, nor is there any sudden change of habitat in a vertical direction; this does not, of course, exclude the possibility that the species may gradually, with increasing age, move down to greater depths (e. g. *Gonostoma denudatum*).

It may here be further added, that certain species, after the migration (passive or active?) of the metamorphosis stages, remain in the great depths to which their migrations have led them (e. g. *Cyclothone signata*), while others again move upwards after that migration (e. g. *Vinciguerria attenuata*). Consequently, then, the numerous species will be found to differ enormously in respect of vertical distribution throughout their life-cycle: egg — larva — post-larva — metamorphosis stage — adolescent stage — mature stage (this last has, perhaps, moreover, in the case of certain species, a varying vertical distribution according as it is nearer or farther from the breeding period). As regards vertical seasonal migration in the Mediterranean, reference may be made to the same work p. 14, as something similar also applies to the species of this family. How far this may be due to movement of the food matter, intensity of light in summer and winter, currents, or other hydrographical conditions, is not determined. As the migration embraces post-larval and adolescent stages, as well as adults, it has evidently nothing to do with propagation.

Gonostoma denudatum, Raf.

The postlarvæ have been described by Sanzo in the work above mentioned. The species is found distributed throughout the greater part of the Mediterranean; the younger stages are found in the upper water layers.

Cyclothone signata, Garman and *microdon*, Günther (?).

Regan (1916) has figured a postlarva (fig. 5, Pl. V) noted as *Cyclothone microdon*, Günther. We may here refer to this figure, which nicely shows the appearance of the postlarva, but we should point out that the most marked difference between the postlarvæ

of the two Mediterranean species lies in the fact that *Cyclothone signata* has no pigment at and on the base of the caudal fin, whereas the other form has here abt. 4 small pigment spots which are entirely constant as to position. It is doubtful whether the dark form in the Mediterranean is identical with the *Cyclothone microdon*, Günther of the Atlantic; in any case, it differs from this in being a dwarf form, which rarely attains more than 25 mm ex. C, while the dentition also, and other features, are dissimilar. The arrangement of gill-rakers has proved of great value in distinguishing between the species.¹⁾ Both species are distributed throughout the whole of the Mediterranean and many thousand postlarval and adult stages have been found. The postlarvæ live in the very uppermost water layers, until metamorphosis, which takes place at 11—14 mm ex. C; the adult stages live at great depths; the dark form deepest down, as shown by Hjort 1912.

Ichthyococcus ovatus (Cocco).

Sanzo has described a postlarva, which is referred to this species (R. Comitato Talassografico Italiano, Memoria XXVII, 1913). This is doubtless entirely correct; we should, however, point out that the metamorphosis stage has not yet been found. The reduction during metamorphosis is evidently very great, as we have post larvæ of the type shown up to 23₅ mm ex. C, and the smallest Mediterranean stages with all photophores etc. are 14 mm ex. C. The metamorphosis stage therefore, which forms the transition from the postlarva to the widely different appearance of the adult fish, would be most interesting. In the Mediterranean, the species has been taken especially in the waters round Italy; the postlarval stages in higher water layers than the adults and adolescent stages (abt. 150 metres as against abt. 500—800 m.)

Vinciguerria attenuata (Cocco), *Vinciguerria Poweriæ* (Cocco),
and *Vinciguerria Sanzoi*, nov. sp. (Figs. 1—6).

The Italian ichthyologists have constantly maintained two forms of the genus in the Mediterranean, while others, (Lütken, Brauer)

¹⁾ Cf. E. Zander: Das Kiemenfilter der Teleosteer. Z. wiss. Zool. Vol. 84. 1906.

have expressed doubt as to the justification of this. Sanzo has described the postlarvæ of the two Mediterranean species, and has thus placed it beyond all doubt that there really exist two species in the Mediterranean. (R. C. T. I., Memoria XXXV, 1913).

From the Atlantic, there are three forms, the two mentioned, and another not yet described. Brauer (1906) has noted specimens from the Atlantic under the name of *Vinciguerria lucelia*, Garman; probably, the material included all three species. We give below some of the principal specific characters for the three species, which will, with the figures, show the difference between them. We may add that Garman's description (1899) of *Vinciguerria lucelia*, together with his figure, does not permit of any determination as to whether the Pacific form is identical with any of the three from the Atlantic.

	<i>V. attenuata</i>	<i>V. Poweriæ</i>	<i>V. Sanzoi</i>
Pos. of anus:	see fig.	see fig.	see fig.
Photophores: VO:	7, 8, 9.	8, 9, 10.	9, 10, 11.
SO:	lacking.	lacking.	present.
Number of gill-rakers			
in 1. branchial arch:	4+9+5.	3+8+4.	5+9+5.
Eye:	slightly telescopic.	not tele- scopic.	not tele- scopic.
N. of vertebræ:	40, 41.	38, 39.	41 (1 spec.)
N. of rays in A:	14, 15, 16.	12, 13, 14.	14, 15.

There are also some smaller differences in the n. of photophores in other groups of same, in the distances of the photophores one from another, their mode of formation in the metamorphosis stages, in the appearance of the dentition, and n. of teeth in individuals of equal size of the three species, in the position of the liver lobe, in the position of dorsal and anal fins relative one to the other, in the proportions, etc. (see also L. Facciola, *Il Naturalista Siciliano* II, 1882—83, Palermo).

In the Mediterranean, the distribution of the two species is particularly striking, *Vinciguerria attenuata* being found throughout the whole of the Mediterranean, *Vinciguerria Poweriæ* only toward the east, roughly speaking, from Sardinia-Corsica eastward.¹⁾

¹⁾ Cf. Johs. Schmidt: *Argentinidæ etc.* „Report on the Danish Oc. Exp.“ Vol. II. A. 5, p. 35.

All three species have been taken in the Bay of Cadiz, and in the North Atlantic, their area of distribution lies south of 40° N. Lat. The species in the Mediterranean are taken chiefly at a depth of abt. 150 m, the postlarvæ on the whole somewhat higher.

Maurolicus Pennanti (Walb.).

The postlarva has been described by Holt and Byrne.¹⁾ There does not appear to be any essential difference between adult individuals from the Atlantic (north of 45° N. Lat.) and from the Mediterranean; the postlarvæ from the Atlantic, on the other hand, are on the whole more strongly pigmented than postlarvæ from the Mediterranean, and there is also a marked difference in size between the postlarvæ from the two areas (Mediterranean specimens of 7 mm for instance are quite as far advanced in development as Atlantic specimens of 9 mm). Possibly further points of difference may be found, and it would then be most correct to adopt the names *borealis*, Nilsson and *amethystino-punctatus*, Cocco for the varieties — the North-Atlantic and the Mediterranean forms respectively.

The distribution of the species in the Mediterranean and the Atlantic seems to coincide closely with the distribution of *Myctophum glaciale* (Reinhardt); like this, *Maurolicus Pennanti* also goes into the Sea of Marmora (the only one of the *Sternoptychidae* that does so). Practically only postlarval and adolescent stages were taken in the Mediterranean at a depth of abt. 150 m.

Argyropelecus hemigymnus, Cocco, etc.

This species, like the others coming under this genus has, as mentioned, been dealt with by P. Jespersen 1915. It should here merely be added, that postlarval stages of *Sternoptyx diaphana* is distinguished *inter alia* by having the eye circular (not oblong, like the *Argyropelecus* larvæ, cf. Brauer 1906 and Vedel Tåning 1918, p. 153) and also in having a belt of highly translucent pigment about the posterior portion of the vertebral column.

¹⁾ „Fisheries, Ireland, Sci. Invest., 1912, I (1913).“

Bonapartia pedaliota, Goode and Bean (Figs. 7—8).

To this species must be reckoned a number of small individuals and some few larger ones from the Atlantic. The species has been described by Goode & Bean 1895, but the text and figure are not altogether in agreement with one another, and the number and position of the photophores, n. of fin rays, etc. differ not a little in the present material as compared with that of Goode and Bean. We therefore note here the values most frequently met with and give a figure. N. of fin rays: D 17, A 30, P 16, V 8, C 8+(10+9)+4. Gill-rakers of 1. branchial arch: 6+8+4. Photophores: Orb. 1, Op 1+2, SO 1, Br 12, BO 14, VO 5, AO 19 (17+2).

Of postlarval stages, there are individuals down to abt. 8.5 mm ex. C; these have still no photophores, but the position of the fins, proportions, eye, pigment, etc. show distinctly agreement with the somewhat older specimen here figured. At a length of abt. 9.5 mm the formation of the photophores commences; the ones first formed are the middle Br, lower posterior Op and posterior BO.

The genus appears in certain respects to resemble *Gonosoma* (formation and position of photophores, position of fins, dentition.) The species has been taken in the Bay of Cadiz, and in the Northern Atlantic south of the latitude of the Azores, only in the west going farther to the northward (42° 19' N. Lat., 50° 22' W. Long.) The postlarvæ have chiefly been taken at a depth of abt. 150 m, the older stages at abt. 500 metres.

Sternoptychid-larva A.

Holt and Byrne have described, in „Biscayan Plankton“, 1907, a „*præscope*“-larva (fig. 2, p. 195)¹⁾ which is not, however, referred to any particular genus. In our material, we have from 37° 03' N. 9° 15' W, a specimen of similar appearance; length 18 mm ex. C., 21 mm incl. C. We suppose that it will prove to belong to a species very nearly related to the above (pigmentation, position of fins, formation of photophores, shape of eye, etc.; it should further be added, that infracaudally, there are unpigmented indications of a pair of organs as in *Bonapartia pedaliota*, and

¹⁾ Fig. 3 is the postlarva of *Argyropelecus hemigymnus*, Cocco.

the rudimentary lower rays of the caudal fin are also as in this species, see fig. 7).

Sternoptychid-larva B. (Figs. 9—10).

We have a number of postlarvæ of the type shown, from about the same area as *Bonapartia pedaliota* (but not from the Bay of Cadiz). We have placed them here, as they resemble this group in several respects (position of fins, length of A and D, formation of photophores — Op however first of all organs — pigment of air-bladder; but round eye and no caudal pigment.)

The postlarvæ were chiefly taken at a depth of abt. 75—150 m (cf. the postlarva with the postlarva of *Valenciennellus tripunctulatus*).

Margrethia obtusirostra, nov. gen. et sp. (Figs. 11—12).

The species shown appears in many respects to resemble the genus *Bonapartia*, as for instance in the position of the photophores, and their formation, the long anal fin, the oval eye in the postlarva etc., but there are some considerable points of difference as compared with this genus, the position of anal and dorsal fins, the presence of an adipose fin, etc. rendering it unlike this.

N. of fin rays: D 16, A 23—26, P abt. 14, V 8, C 7 + (10 + 9) + 6; adipose fin. Gill-rakers in 1. branchial arch: 5 + 7 + 3. Photophores: Orb. 1, Op 1 + 2, SO? ¹⁾, Br 12, BO 14—15, VO 4, AO 17 (13 + 4).

The present specimens, which are all postlarval or adolescent stages (from 6.7 to 19 mm ex. C.) were almost exclusively taken at a depth of abt. 150 metres; the distribution closely coincides with that shown by *Bonapartia pedaliota* (Cadiz Bay, south of the latitude of the Azores).

Survey of Sternoptychidæ with only one longitudinal row of photophores on body.

With characters of the family *Sternoptychidæ*, Günther.

¹⁾ This organ is not seen in the largest specimen, but as it is formed late in other species, possibly still larger specimens may possess it.

The photophores are not grouped together, but lie separately (no fusion).

There are no photophores on the isthmus (this is also the case with the genera *Gonostoma* and *Cyclothone*, but not with any other *Sternoptychidæ* which we know.)

In contrast to what is found in all other *Sternoptychidæ*, the photophores are in only one longitudinal row on the body.

A. Anterior margin of dorsal slightly in rear of the vertical from anterior margin of anal. Adipose fin lacking.

Bonapartia, Goode & Bean.

The type of this genus is *Bonapartia pedaliota*, G. & B.

The fully grown individuals of the above-mentioned *Sternoptychid*-larvæ A and B will probably be found to belong to this section.

B. Anterior margin of dorsal lies slightly in front of the vertical from anterior margin of anal. Adipose fin present.

Margrethia, nov. gen.

The type of this genus is the *Margrethia obtusirostra*, nov. sp. mentioned above and figured Pl. XVII.

Yarella Blackfordi, Goode and Bean (Fig. 13).

As will be seen from the figure and the characters given below for the present specimens, these do not entirely agree with the description given by Goode & Bean (1895) of *Yarella Blackfordi*. For the present, however, we have considered it best to place the specimens under this specific name.

N. of fin rays: D 10—12, A 22—26, P 8, V 7, C 10—12 + (10 + 9) + 3—4; adipose fin. Photophores: Orb. 1, Op 1 + 2, SO 1, Br 8, IO 22 (9 + 13), VO 7—8, AO 19—21, LO 20—21 (12 + 1 + 7—8).

The species was taken in quite considerable quantities of adolescent and adult stages from 16 mm to 43 mm ex. C. in the area south of 40° N Lat., and west of abt. 35° W; mainly at a depth of 30—75 m.

Goode and Bean write of this genus: „This genus is in several respects intermediate between *Gonostoma* and *Photichthys*“. With regard to this, however, we should point out that the genus to which our specimens belongs must be considered very closely

related to *Vinciguerria*, Jordan and Evermann; this is seen *inter alia*, in the position of the fins, position and formation of the photophores, dentition, gill-rakers etc.

Diplophos tænia, Günther (Fig. 14).

Of this species, we have abt. 40 specimens from a length of 17 mm (postlarva with diphycercal tail) to adult stages of 48 mm ex. C. When the postlarva has reached a length of abt. 46 mm, the photophores commence to form, and at the same time, a great reduction in length takes place, with up to $\frac{1}{3}$ of the total length. The pigmentation of the postlarvæ is, as shown in the figure, very characteristic, and remains of the postlarval pigment are found in the adolescent stages. The specimens were taken chiefly at the surface. In the area investigated of the Atlantic, the principal distribution lies south of 40° N. Lat., and west of 40° W. Long, though some specimens were found eastward to 20° 36' W. Long.

Diplophos minutus, nov. sp. (Fig. 15).

Of this species we have some ten individuals, the largest measuring 21 mm ex. C. The proportions etc. will be seen from the accompanying sketch. The species seems to be more nearly related to *Diplophos pacificus*, Günther than *Diplophos tænia*, Günther. All the specimens exhibit diffuse pigment, and have only little of the postlarval appearance remaining. Probably, not all the photophores have been formed on the head (cf. *Diplophos tænia*).

N. of fin rays: D 10—12, A 37—39, P 9, V 8, C 6 + (10 + 9) + 4. Gill-rakers in 1. branchial arch: 4 + 7 + 2. Photophores: Orb. 2, Op 1 + 2, SO 1, (there is also one other organ on the lower jaw, a little farther back), Br 9, IO 30, VO 1 + 11—12 (the foremost lies between the ventral fins), AO 28—30, PO 1, LO I 46—47, LO II 65—66.

The species was taken in the upper water layers, and in the area investigated, it was only found in that part of the Northern Atlantic which lies south of 40° N. Lat. and west of 50° W. Long.

Valenciennellus tripunctulatus, Esmark (Fig. 16).

This very characteristic species resembles, in the postlarva, the *Sternoptychid*-larva B, but is easily distinguished therefrom by the

oval eye and the fact that the Br organs are first formed. (Cf. Brauer (1906) p. 101, fig. 42). The species is fairly commonly distributed from the Bay of Cadiz in the North Atlantic south of abt. 40° N. Lat.; like several other species, it is found somewhat farther north nearer the American side.

In the foregoing, the following abbreviations have been employed. The number of gill-rakers has only been noted for the first branchial arch, and the figures indicate: number situated on *epibranchiale* + n. on *veratobranchiale* + n. on *hypobranchiale* e. g. 5 + 9 + 5).

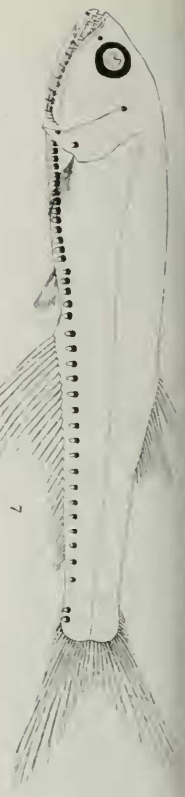
The abbreviations for photophores are as follows: Orb. indicates organs situated in the region of the eye, Op on the operculum, SO at the symphysis of the lower jaw, Br on the branchiostegal membrane, IO on the isthmus and abdomen to the ventral fin (V), BO organs on the abdomen alone (from the head to the V), VO between V and the anal fin (A), CO from the anterior margin of the A to the caudal fin (C), LO organs situated laterally, LO I lowest, LO II upper lateral row, PO at base of the pectoral fin (P). D indicates the dorsal fin.

Explanation of the Plate XVII.

- 1.¹ *Vinciguerria Poweriæ*. (Cocco). Adolescent stage, 21.8 mm ex. C.; „Thor“, St. 158, ³¹ 7 10, 300 m w. out.
2. — *Sanzoi*, sp. nov. Adolescent stage, 20.8 mm ex. C.; „Thor“, St. 231, ⁹ 9 10, 25 m w. out.
3. — *attenuata*, (Cocco). Adolescent stage, 20.8 mm ex. C.; „Thor“, St. 46, ⁷ 2 09, 600 m w. out.
4. — *Poweriæ*, (Cocco). Postlarval stage, 20 mm ex. C.; „Thor“, St. 186, ¹⁷ 8 10, 65 m. w. out.
5. — *Sanzoi*, sp. nov. Postlarval stage, 14.8 mm ex. C.; „Margrethe“, St. 1068, ¹¹ 12 13, 65 m w. out.
6. — *attenuata* (Cocco). Postlarval stage. 18.8 mm ex. C.; „Thor“, St. 132, ¹⁴ 7 10, 300 m w. out.

¹) The dotted line in figs. 1—3 indicates the abdominal cavity. Photophores situated on the isthmus, the branchiostegal membrane etc. (e. g. photophores only visible through the operculum etc.) are indicated in an other way than the remainder photophores.

7. *Bonapartia pedaliota*, Goode and Bean. Adult stage, 51 mm ex. C.; „Thor“, St. 89, ¹⁸/₁₀ 10, 1000 m w. out.
8. — — Postlarval stage. 16 mm ex. C.; „Margrethe“, St. 1017, ³/₉ 13, 300 m w. out.
9. *Sternoptychid*-larva B, Postlarval stage, 16.7 mm ex. C.; „Margrethe“, St. 1021, ¹⁴/₉ 13, 150 m w. out.
10. — — Postlarval stage. 6.2 mm ex. C.; „Margrethe“, St. 1072, ¹⁸/₁₂ 13, 300 m w. out.
11. *Margrethia obtusirostra*, nov. gen. et sp. Adolescent stage, 19 mm ex. C.; „Margrethe“, St. 1072, ¹⁸/₁₂ 13, 300 m w. out.
12. — — Postlarval stage, 7.1 mm, ex. C.; „Margrethe“, St. 1060, ²⁹/₁₁ 13, 300 m w. out.
13. *Yarella Blackfordi*, Goode and Bean. Adult stage, 42 mm ex. C.; „Margrethe“, St. 1041, ²²/₁₀ 13, 150 m w. out.
14. *Diplophos tania*, Günther. Postlarval stage, 44 mm ex. C.; „Ingolf“, St. 432, ¹¹/₁₁ 11, surface.
15. — *minutus*, sp. nov. Adolescent stage, 17 mm ex. C.; „Margrethe“, St. 1066, ¹⁰/₁₂ 13, 65 m w. out.
16. *Valenciennellus tripunctulatus*, Esmark. Postlarval stage, 11 mm ex. C.; „Margrethe“, St. 1072, ¹⁸/₁₂ 13, 300 m w. out.



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